

**UTILITY
PATENT APPLICATION
TRANSMITTAL**

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.

35.C14549

First Named Inventor or Application Identifier

JUN TAMAI

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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ☒ Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. ☒ Specification *Total Pages* **21**
3. ☒ Drawing(s) (35 USC 113) *Total Sheets* **4**
4. ☒ Oath or Declaration *Total Pages* **1**
- a. ☒ Newly executed (original or copy)
- b. ☐ Unexecuted for information purposes
- c. ☐ Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed)
[Note Box 5 below]
- i. ☐ **DELETION OF INVENTOR(S)**
Signed Statement attached deleting
inventor(s) named in the prior application, see
37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference (useable if Box 4c is checked)
The entire disclosure of the prior application, from which a copy of
the oath or declaration is supplied under Box 4c, is considered as
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6. ☐ Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
- a. ☐ Computer Readable Copy
- b. ☐ Paper Copy (identical to computer copy)
- c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ☒ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney
(when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
14. ☐ Small Entity ☐ Statement filed in prior application
Statement(s) Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
16. ☐ Other: _____

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No. _____**18. CORRESPONDENCE ADDRESS**☒

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CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	17-20 =	0	X \$ 18.00 =	\$ 0.00
	INDEPENDENT CLAIMS (37 cfr 1.16(b))	2-3 =	0	X \$ 78.00 =	\$ 0.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			\$ 260.00 =	\$ 0.00
				BASIC FEE (37 CFR 1.16(a))	\$ 690.00
	Total of above Calculations =				\$ 690.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
	TOTAL =				\$ 690.00

19. Small entity status

- a. ☐ A Small entity statement is enclosed
- b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
- c. ☐ Is no longer claimed.

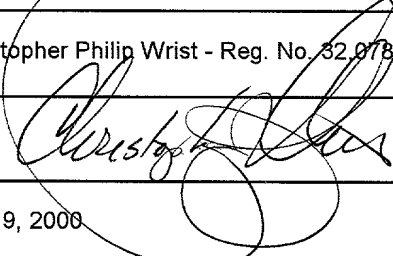
20. ☒ A check in the amount of \$ 690.00 to cover the filing fee is enclosed.

21. ☒ A check in the amount of \$ 40.00 to cover the recordal fee is enclosed.

22. The Commissioner is hereby authorized to credit overpayments or charge the following fees to Deposit Account No. 06-1205:

- a. ☒ Fees required under 37 CFR 1.16.
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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

NAME	Christopher Philip Wrist - Reg. No. 32,978
SIGNATURE	
DATE	June 9, 2008

CPW\cmv

VIBRATION WAVE DRIVING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

5 This invention relates to a vibration wave driving apparatus having an output shaft.

Related Background Art

Several vibration motors (vibration wave driving apparatuses) having output shafts are known. For example, as shown in Fig. 4 of the accompanying drawings, there is a motor disclosed in Japanese Patent Application Laid-Open No. 5-38170. This motor is such that piezoelectric elements 142 and 144 are disposed between metallic blocks 150 and 152 as hollow cylindrical elastic members and the two metallic blocks 150 and 152 are coupled together into a vibration member 140 by a cylindrical coupling bolt 154 disposed on the inner peripheral side of these metallic blocks 150 and 152. On the other hand, a motor housing (outer case) 170 is such that the cylindrical portion of the central portion of a motor forms a motor supporting portion and a bearing 172 is disposed in the motor supporting portion and supports an output shaft 134, and a ring-shaped flange portion 175 provided on the inner diametral portion of a coupling bolt 154 is fixed to the motor supporting portion and supports the vibration member 140.

Also, a rotor portion 130 as a contact member is disposed on one side of the vibration member 140, and this rotor portion 130 is of a construction in which a spring 133 is disposed between a fixed rotor body (disc) 132 and a support plate 136 in the direction of rotation of the output shaft 134, and the rotor body 132 is brought into pressure contact with the end surface of the metallic block 152 by the spring force of a spring 133.

In the above-described example of the prior art, however, the bearing is one and therefore, when a force is applied from a side to the output shaft, the output shaft is inclined with the aforementioned bearing as a fulcrum, and the rotor portion deviates relative to the vibration member. As the result, the frictional contact state in a rotor contact surface 160 wherein the rotor body 132 contacts with the metallic block 152 becomes non-uniform, and there have arisen problems such as a reduction in the efficiency of the motor, the occurrence of noise and the wear of the contact surface (a reduction in the life of the motor).

SUMMARY OF THE INVENTION

One aspect of this invention is to provide a vibration type driving apparatus wherein a vibration member is supported in a case thereof by a support

member and an output shaft is supported by the bearings at the opposite end portions of the case, and the output shaft is extended through a through-hole in the axial center portions of the vibration member and a rotating member, and the through-hole of the vibration member is used as a sliding bearing for the output shaft, whereby which can stably drive even if extraneous forces act on the output shaft from various directions.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view of a vibration type driving apparatus according to a first embodiment of the present invention.

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Fig. 2 is a cross-sectional view of a vibration type driving apparatus according to a second embodiment of the present invention.

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Fig. 3 is a cross-sectional view of a vibration type driving apparatus according to a third embodiment of the present invention.

Fig. 4 is a cross-sectional view of a vibration type driving apparatus according to the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

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[First Embodiment]

Fig. 1 shows a first embodiment of the present invention.

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In a vibration wave driving apparatus according to this embodiment, a circular ring-shaped piezoelectric element 4 as an electro-mechanical energy conversion element and a vibration member supporting member 3 formed by a thin plate of a metal or the like are sandwiched between bar-like hollow metallic members 5 and 6 as two elastic members, and these metallic members 5 and 6 are held and fixed by a hollow bolt 1 and a nut 7 made of a metal which are fastening members to thereby constitute a vibration member.

The vibration member in the present embodiment combines two bending vibrations and forms circular or elliptical motion on a driving surface, and the driving principle thereof is described in Japanese Patent Application Laid-Open No. 3-011981, etc. and is already well known and therefore need not be described. The vibration member may be one which combines not only two bending vibrations, but also, for example, a torsional vibration and a longitudinal vibration. There is a hole in the axial center portion of the vibration member, and the vibration wave driving apparatus of the present embodiment need be a vibration wave driving apparatus of a form in which an output shaft 2 extends through this hole.

In the vibration wave driving apparatus of the present embodiment, a rotary member 8 is disposed on

one side of the vibration member, and a cylindrical frictional sliding member 8a is fixed to the outer peripheral portion of the rotary member 8 and the fore end portion of the frictional sliding member 8a which is adjacent to this rotary member is adapted to contact with a frictional sliding member 5a on the vibration member side which is provided on the outer peripheral end portion of the end surface of the metallic member 5 constituting the vibration member.

10 The rotary member 8 is fitted to the outer diametral portion of a pressing spring 9 which is a hellevill spring having its coaxiality and inclination with respect to the output shaft 2 regulated by a caulking member 12, and the sliding member 8a of the rotary

15 member 8 and the frictional sliding member 5a on the vibration member side are adapted to be brought into pressure contact with each other by the spring force of the pressure spring 9.

The vibration member in the present embodiment is constructed with the vibration member supporting member 3 sandwiched and fixed simultaneously with the piezoelectric element 4. The vibration member supporting member is disc-shaped, and the outer peripheral portion thereof is joined to the

25 confronting surfaces of the case portions 15 and 16 of an external case of a two-division construction. This joint is carried out by electric resistance

welding, laser welding, adhesion by an adhesive agent or brazing.

5 The role of the vibration member supporting member 3 is to support the vibration member, but if the vibration member supporting member is too thick and too great in rigidity, a vibration generated by the vibration member is transmitted to the aforementioned case, and vibration energy of high efficiency comes to be not generated. Therefore, the vibration member supporting member 3 has suitable flexibility. Because of it, the vibration member has its spatial position not firmly determined relative to the external case, and becomes inclined or eccentric.

10 As the result, the vibration of the vibration member is not efficiently transmitted to the frictional sliding member 8a of the rotary member 8 and the following problems arise.

1. Creation of motor noise
2. Reduction in motor life due to the localized wear of the frictional sliding member
3. Reduction in motor efficiency

20 In order to prevent these evils, in the present embodiment, the through-hole 1a of the hollow bolt 1 plays the role of a bearing supporting the output shaft 2.

In the present embodiment, a sintered metallic oil-containing bearing 11 is caulked to one external

case portion 15, and on the opposite side, a ball bearing 10 is forced into the other external case 16. The output shaft 2 is supported by those two bearings 10 and 11.

5 Further, two snap rings 17 are disposed so as to sandwich the ball bearing 10 therebetween from the opposite sides and therefore, the output shaft 2 has its spatial position determined relative to the
10 aforementioned external case. That is, the position of the output shaft 2 is first determined relative to the external case, and the through-hole 1a acts as a bearing relative to the output shaft 2 and thus, the position of the vibration member is determined.

15 On the other hand, the rotary member 8 is fitted to the outer diametral portion of the pressing spring 9 having its coaxiality and inclination with respect to the output shaft 2 regulated by the caulking member 12. Consequently, the rotary member 8 has its spatial
20 position substantially determined relative to the output shaft 2.

 Thus, the vibration member and the rotary member 8 have their positions determined with the output shaft 2 as the reference and therefore, the frictional sliding member 8a on the rotary member side and the
25 frictional sliding member 5a on the vibration member side become capable of stably contacting with each other.

In the present embodiment, vibration preventing rubber 23 is interposed between the rotary member 8 and the pressing spring 9, whereby the vibration of the rotary member 8 can be prevented from propagating to the output shaft 2, and the vibration preventing rubber 23 also performs the role of joining the rotary member 8 and the pressing spring 9 together.

Near the ball bearing 10, a rotary plate 13 which is a part of an encoder for detecting the rotated position is fixed to the output shaft 2. The rotary plate 13 is formed with a number of holes in radial directions, and the rotation of the rotary plate is counted by the interception and passage of light from a photointerrupter 14 fixed to the inner side of the case 16 to thereby detect the position. If the photointerrupter 14 is one of a fiber type which can obtain thin rays of light, the resolving power will be improved and the positioning accuracy will also be heightened and therefore, it is more desirable.

In the present embodiment, a sensor of a light detecting type is used as the photointerrupter, but a potentiometer or the like for detecting the rotated position by a vibration in an electrical resistance value may be contained in the case.

[Second Embodiment]

Fig. 2 shows a second embodiment of the present invention.

A vibration member in this embodiment, unlike that in the first embodiment, does not use a hollow bolt which is a fastening member. Metallic members 5 and 6 as two elastic members, a vibration member 5 supporting member 3 and a piezoelectric element 4 are adhesively secured and coupled together by an adhesive agent.

In the present embodiment, frictional sliding portions are provided on the opposite ends of the vibration member, and two rotary members 8 are also provided. Thereby, usually as compared with a motor having a rotary member, the created torque becomes double. Also, a large-diametered hole portion is formed in the axis of each rotary member 8 from the outer end side thereof, and the inner end portion side thereof is made small in diameter, and a pressing coil spring 9 is disposed in this large-diametered hole portion so as not to slip off.

Also, a rotation stop 12 is mounted in the aforedescribed large-diametered hole portion on the outer end portion side of each rotary member 8, and a spline is formed in the outer periphery of the rotation stop 12 and is fitted to the rotary member 8. The rotation stop 12 is inserted into the inner spline portion of the rotary member 8 while being forced onto the output shaft 2 and compressing the pressing spring 9. The rotary members 8 have the rotation restrained

relative to the rotation stops 12, but can freely slide in the axial direction thereof. Consequently, only the rotational forces of the rotary members 8 can be transmitted to the output shaft 2.

5 Flanged sliding bearings 18 are provided on the inner diametral end portions of the metallic members 5 and 6 as elastic members. In the present embodiment, as the bearing portions of the sliding bearing 18, use is made of bearing portions made of polyacetal, but
10 depending on the temperature at which the motor is used, a material having good heat resistance such as Nylon, Teflon or PPS is preferable in some cases.

 In the present embodiment, the sliding bearings 18 are fixed to the outer sides of the metallic
15 members 5 and 6 as elastic members, and the output shaft 2 is rotated relative to the sliding bearings 18, but the output shaft 2 and the sliding bearings 18 may be fixed and the sliding bearings 18 and the metallic members 5 and 6 may be made rotatable
20 relative to each other. In this case, the output shaft 2 may be covered with a heat-contracting tube made of resin or the output shaft 2 may be coated with resin such as Teflon. Further, if oil is contained in the interior of the resin, the output shaft 2 can be
25 rotated more smoothly and this is desirable.

 This oil does not flow out to the outside and

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therefore, there is no fear that the oil goes round to the frictional sliding portion of the vibration member or the rotary member. Also, vibration leakage is preferably little if the sliding bearings 18 are
5 disposed at positions which are the nodes of the vibration of the vibration member. The sliding bearings 18 may be made of an oil-containing sintered metal, but may more desirably be made of resin because in the case of such metal, noise is liable to occur
10 due to the vibration of the vibration member.

The vibration member and the rotary member are assembled together in advance outside the case with the rotation stops 12 forced onto the output shaft 2, and the assembly is inserted into an external case 30
15 molded by press drawing.

The vibration member supporting member 3 has three radially outwardly extending legs, and as shown in Fig. 2, the tip end portion of each leg is bent and therefore, the insertion of the vibration member
20 supporting member into the external case 30 can be done smoothly. When the rotation stop 12 strikes against a sliding bearing 11 of a sliding bearing type, the vibration member is rotated relative to the external case about the output shaft, and the three
25 legs of the vibration member supporting member 3 are fitted into three holes 30a formed in the external case 30 by the utilization of their elastic forces of

restitution.

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The number of the legs of the vibration member supporting member is not limited to three, but may be one. The role of the supporting member is to prevent the vibration of the vibration member from being transmitted to the case, and resist a torsional force applied to the vibration member. The displacement of the vibration member near the center thereof is minute and substantially at a right angle with respect to the output shaft and therefore, the supporting member is designed to be soft in this direction and be rigid in the direction of torsion of the vibration member.

A lid member 31 is fitted to the external case 30, and at this time, a spacer 19 made of resin is put onto the output shaft 2. By virtue of this spacer 19, any unreasonable force is not applied to the vibration member supporting member 3, etc. even when an axial force is applied to the output shaft 2.

Lastly, the vibration member supporting member 3 was soldered to the hole 30a of the external case 30, and the external case 30 and the lid member 31 were joined together by an adhesive agent. In these cases, the joint may be course be done by welding or the like. In the present embodiment, the rotary members 8 are brought into pressure contact with frictional sliding members 5a on the vibration member side by the pressing springs 9, but the reaction forces thereof

are received by the two rotation stops 12 forced onto the output shaft 2 and therefore, there is not any friction loss by forces axially created in the bearings 11.

5 While in the above-described first embodiment, the reaction force created by the pressing spring 9 being pressed is received by the ball bearing 10 of the ball bearing type through the snap ring 17 lying outside the external case, the ball bearing need not
10 be used in the present second embodiment.

Also, frictional sliding members 8a on the rotary member side have their portions corresponding to sliding portions bent. This is means for widening the frictionally sliding area, reducing the surface
15 pressure of a frictionally sliding surface, decreasing the wear of a frictional material, and lengthening the life of the motor.

[Third Embodiment]

Fig. 3 shows a third embodiment of the present
20 invention.

This third embodiment, like the second embodiment, is of a type in which rotary members 8 are provided on the opposite end portions of a vibration member, and a sliding bearing 22 comprised of a
25 sliding bearing similar to the sliding bearing 18 in the second embodiment is provided in the hole portion of the small-diametered portion side on the inner end

side of each rotary member 8. This sliding bearing 22 is made of resin and is forced into the aforescribed bore of each rotary member 8. By virtue of this sliding bearing 22, each rotary member 8 has become rotatable without being eccentric relative to the output shaft 2. Therefore, the irregularity of the rotation of the motor has become little.

Also, in the present embodiment, sliding bearing 32 of a sliding bearing type are forced into the opposite ends of the bore portion of a hollow bolt 1.

A vibration member supporting member 3 is interposed and fixed between external case portions 15 and 21.

Besides a piezoelectric element 4 and the vibration member supporting member 3, a flexible printed substrate 20 is held and fixed between two elastic members 5 and 6, and extends outwardly along the inner surfaces of the external case portions 15 and 21. This flexible printed substrate 20 is used as wiring for the supply of an electric current to the piezoelectric element 4, the supply of an electric current produced by a voltage produced in the piezoelectric element, and further an electric current to a rotated position detecting element like a potentiometer.

As described above, according to the present invention, the positional relation of the output shaft

is determined relative to the through-hole of the vibration member and therefore, the vibration member is not inclined with respect to the output shaft, and even if a sideways force is applied to the output shaft, the contact state of the frictionally sliding surface is stabilized and therefore, the vibration wave driving apparatus of the present invention has become a vibration wave driving apparatus of high efficiency and long life.

10 The bearing is also provided in the through-hole of the rotary member, whereby when the rotary member is rotated, the eccentricity relative to the axis of the vibration member is also decreased and therefore, the motor of the present invention has become a more
15 excellent motor. Further, the bearing surface of the sliding bearing or the surface of the output shaft supported by the bearing surface is made of resin, whereby the occurrence of noise has been suppressed.

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WHAT IS CLAIMED IS:

1. A vibration wave driving apparatus
comprising:

5 a vibration member formed by an elastic
member having an electro-mechanical energy conversion
element fixed thereto, and having a through-hole in
the central portion thereof;

a vibration member supporting member fixed to
said vibration member;

10 a rotary member being in pressure contact
with said vibration member, and having a through-hole
in the central portion thereof;

an output shaft extending through the
through-hole of said vibration member and said rotary
15 member, and rotatable with said rotary member, said
output shaft supporting said vibration member in said
through-holes;

a case packaging said vibration member and
said rotary member therein, and supporting said
20 vibration member with the end portion of said
vibration member supporting member fixed; and

a plurality of bearings for supporting said
output shaft provided in said case.

25 2. A vibration wave driving apparatus according
to Claim 1, wherein the through-hole itself of said
vibration member provides a bearing surface.

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3. A vibration wave driving apparatus according to Claim 1, wherein the through-hole of said vibration member has a bearing supported by said output shaft.

5 4. A vibration wave driving apparatus according to Claim 3, wherein the bearing in the through-hole of said vibration member supported by said output shaft is a sliding bearing.

10 5. A vibration wave driving apparatus according to Claim 4, wherein the surface of said output shaft supporting the sliding bearing or the bearing surface of said sliding bearing is formed of resin.

15 6. A vibration wave driving apparatus according to Claim 3, wherein the bearing supported by said output shaft is disposed substantially at the node position of the vibration of the vibration member.

20 7. A vibration wave driving apparatus according to Claim 1, wherein at least one of the plurality of bearings provided in said case is a sliding bearing.

25 8. A vibration wave driving apparatus according to Claim 7, wherein the surface of said output shaft supported by the sliding bearing or the bearing surface of said sliding bearing is formed of resin.

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9. A vibration wave driving apparatus according to Claim 1, wherein the through-hole of said rotary member has a bearing supported by said output shaft.

5 10. A vibration wave driving apparatus according to Claim 9, wherein the through-hole itself of said vibration member provides a bearing surface.

10 11. A vibration wave driving apparatus according to Claim 9, wherein the through-hole of said vibration member has a bearing supported by said output shaft.

15 12. A vibration wave driving apparatus according to Claim 11, wherein the bearings in the through-holes of said vibration member and said rotary member supported by said output shaft are sliding bearings.

20 13. A vibration wave driving apparatus according to Claim 12, wherein the surface of said output shaft supporting the sliding bearing or the bearing surface of said sliding bearing is formed of resin.

25 14. A vibration wave driving apparatus according to Claim 11, wherein the bearing supported by said output shaft is disposed substantially at the node position of the vibration of the vibration member.

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15. A vibration wave driving apparatus according to Claim 9, wherein at least one of the plurality of bearings provided in said case is a sliding bearing.

5 16. A vibration wave driving apparatus according to Claim 15, wherein the surface of said output shaft supported by the sliding bearing or the bearing surface of said sliding bearing is formed of resin.

10 17. A vibration wave driving apparatus comprising:

 a vibration member formed by an elastic member having an electro-mechanical energy conversion element fixed thereto, and having a through-hole in
15 the central portion thereof;

 a vibration member supporting member fixed to said vibration member;

 a rotary member being in pressure contact with said vibration member, and having a through-hole
20 in the central portion thereof;

 an output shaft extending through the through-holes of said vibration member and said rotary member, and rotatable with said rotary member, said output shaft supporting said rotary member in said
25 through-holes;

 a case packaging said vibration member and said rotary member therein, and supporting said

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vibration member with the end portion of said
vibration member supporting member fixed; and

a plurality of bearings for supporting said
output shaft provided in said case.

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ABSTRACT OF THE DISCLOSURE

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This specification discloses a vibration wave driving apparatus having a vibration member having an electro-mechanical energy conversion element and a vibration member supporting member fixed to an elastic member and having a through-hole in the axial portion thereof, a rotary member being in pressure contact with the vibration member and having a through-hole in the axial portion thereof, an output shaft extending through the through-holes of the vibration member and the rotary member, a case supporting the vibration member with the end portion of the vibration member supporting member fixed, and a plurality of bearings for supporting the output shaft provided in the case, characterized in that the vibration member and the rotary member is packaged, the output shaft is rotated with the rotary member, and the output shaft is supported relative to the through-hole of the vibration member.

FIG. 1

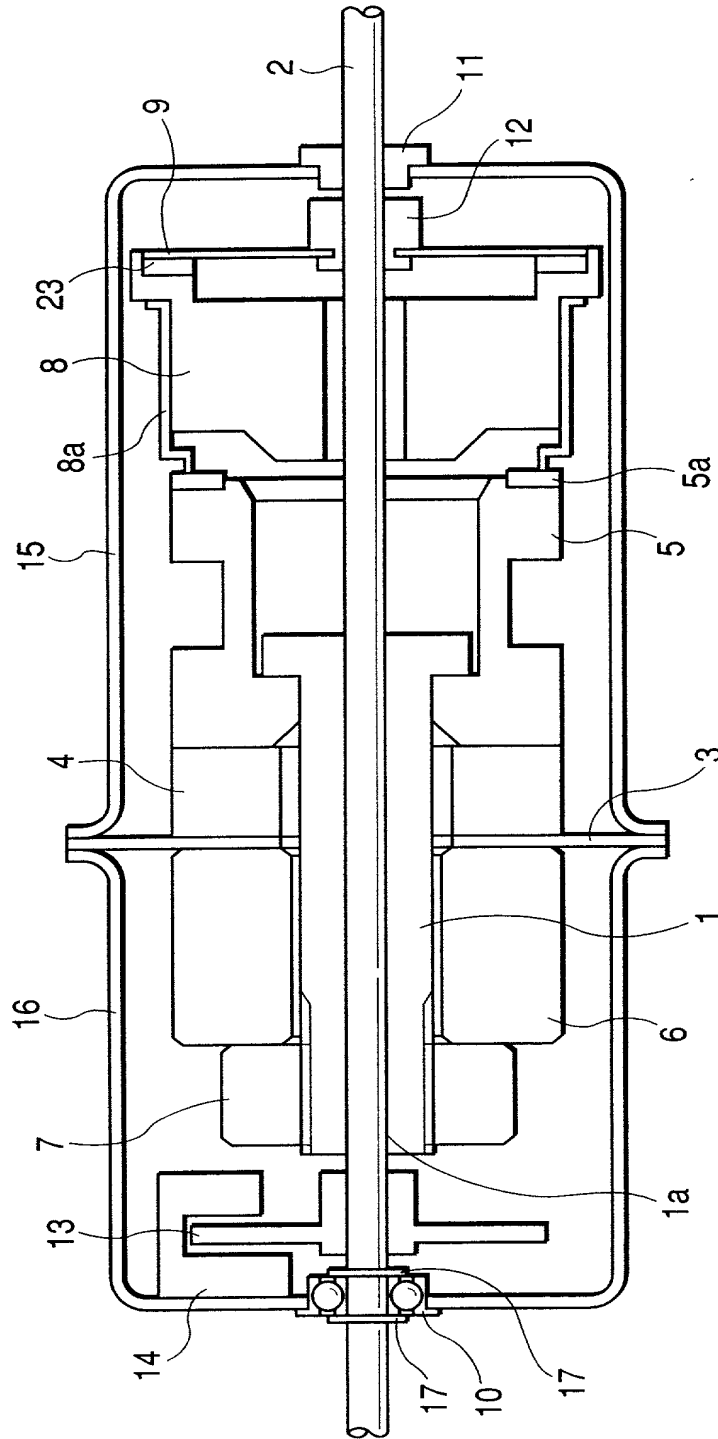


FIG. 2

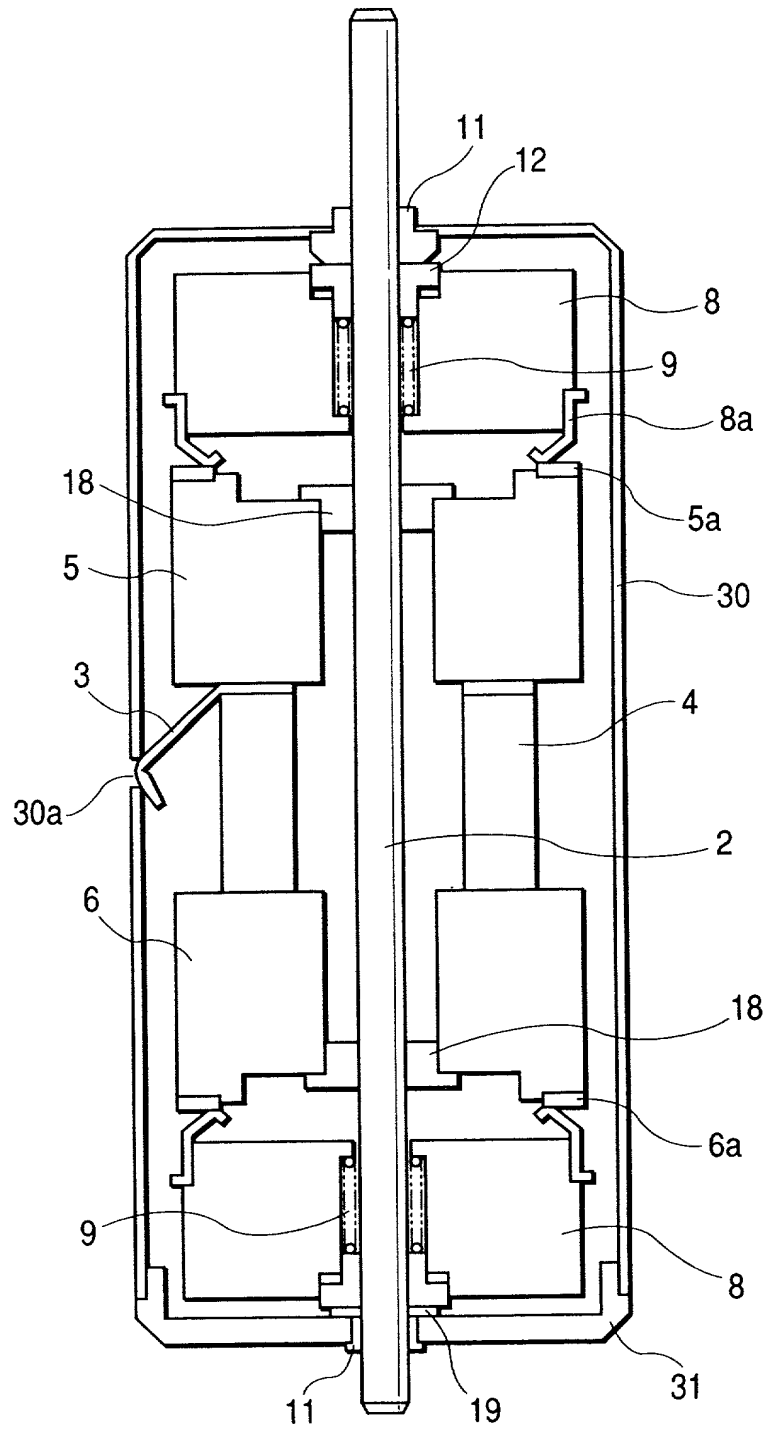


FIG. 3

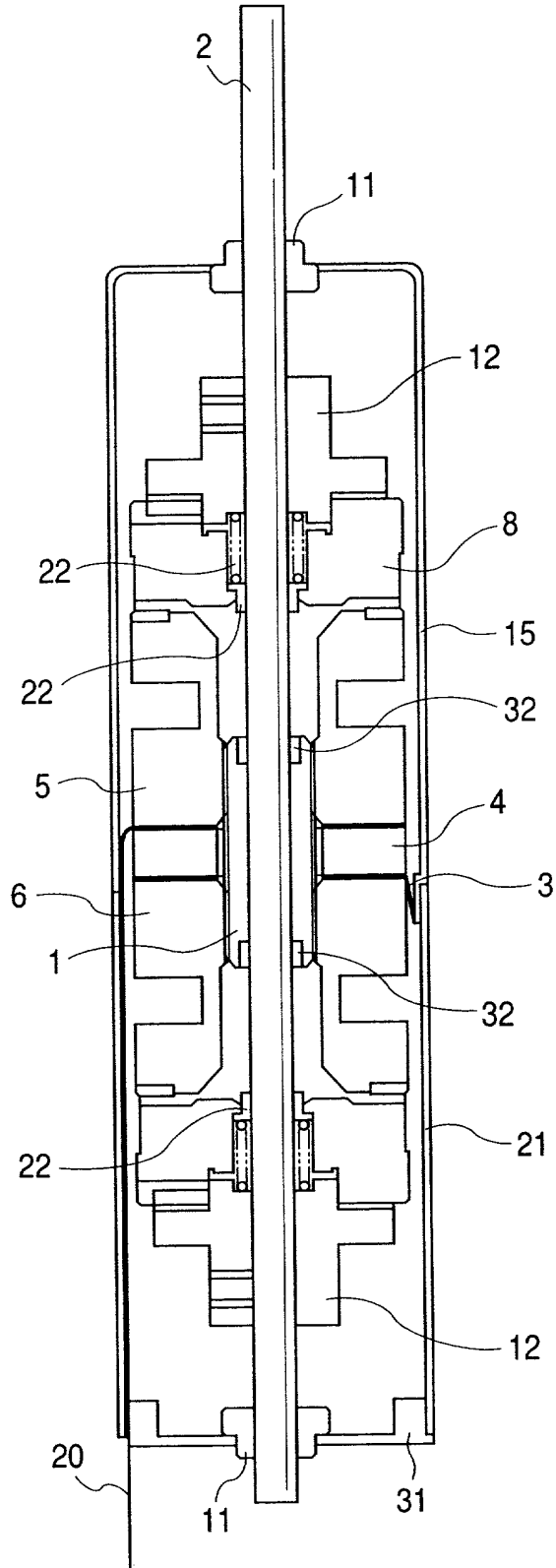
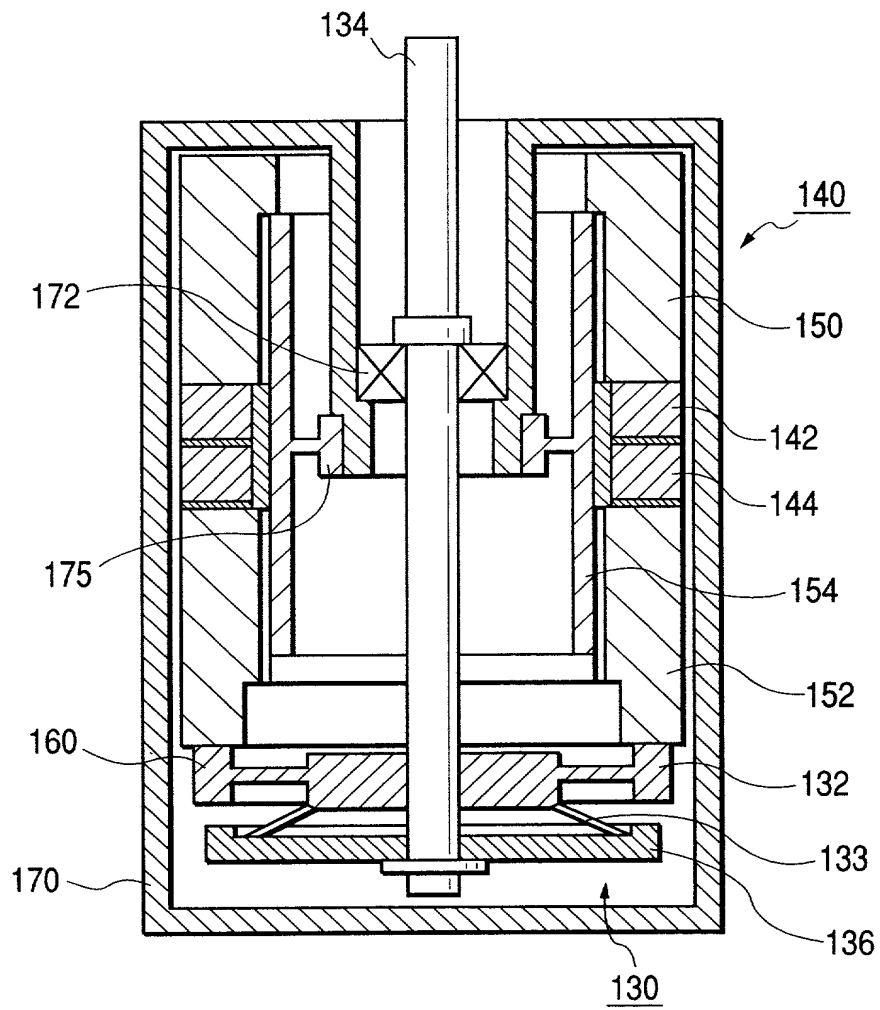


FIG. 4



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COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

(Page 1)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled VIBRATION WAVE DRIVING APPARATUS

the specification of which ☒ is attached hereto ☐ was filed on _____ as United States Application No. or PCT International Application No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b), of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designates at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	(Yes/No) Priority Claimed
JAPAN	11-168185	15 June 1999	Yes

I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

FITZPATRICK, CELLA, HARPER & SCINTO
Customer Number: 05514

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole or First Inventor JUN TAMAI
 Inventor's signature *Jun Tama*
 Date June 5, 2000 Citizen/Subject of JAPAN
 Residence 366-35, Oba-cho, Aoba-ku, Yokohama-shi, Kanagawa-ken, Japan
 Post Office Address c/o Canon Kabushiki Kaisha
30-2, Shimomaruko 3-chome, Ohta-ku, Tokyo, Japan

Full Name of Second Joint Inventor, if any _____
 Second Inventor's signature _____
 Date _____ Citizen/Subject of _____
 Residence _____
 Post Office Address _____

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